POLLINATION OF VERBENA HASTATA

Harvey B. Lovell and John H. Lovell

Verbena hastata L., the purple vervain, is widely distributed from Nova Scotia to British Columbia, southward to Florida and New Mexico. The plant flourishes in damp fields and pastures, and, twice in twenty-four years in Iowa, during years of excessive moisture, it has bloomed in great profusion in low fertile lands and yielded a surplus of mild white honey. Robertson[1] has reported a list of insect visitors for Carlinville, Illinois, but a description of the ecology of this important species has never been published.

The slender whorls of flowers begin to bloom at the base of the spike, the flowering gradually continuing upward to its apex. An average of 6 to 7 flowers bloom at one time but, although each whorl blooms only for a few days, the period of anthesis extends over two months. So close together are the clusters of spikes that honey-bees were observed to cross from one to another without flying. This close grouping also greatly increases the conspicuousness of the inflorescence.

The homogamous flowers are sessile, salver-formed and slightly two-lipped, the two upper corolla-lobes being smaller and nearer together than the three lower. The tubular calyx is five-toothed with the two outer teeth prolonged and bent inward to afford support to the flower when it is visited by large insects. The corolla-tube is 3–4 mm. in length, curving obliquely outward, affording more room for the expanding buds and the most convenient position for the bees while sucking. The limb of the corolla, which often stands nearly vertical, is 5 mm. broad with the entrance to the tube closed by a grating of purplish hairs, except for a small opening in the center through which the proboscis of the bee passes. This ring of hairs is useful in excluding both the rain and very small insects.

The stamens are didynamous; the upper pair of anthers lie close to the entrance to the corolla-tube, while the second pair are on the opposite side of the tube a little lower down. The yellow pollen, which is glutinous, adheres to the anthers after they have dehisced. The style is short, about half the length of the corolla-tube, and two-lobed; the outer lobe is stigmatic, large and bulbous, almost completely filling half of the tube. The inner lobe is much reduced in size

[1] Robertson, Charles, Flowers and Insects, Page 216.

and has become smooth and pointed and no longer functions as a stigma. If both lobes were large, the passage of the bee's tongue would be obstructed. The tube between the anthers and the stigma is largely filled with white hairs, which, however, are not dense enough to prevent the passing through it of the proboscis of a large bee. But they would prevent small insects from creeping down to the nectar. In the absence of insects, self-pollination does not occur. We covered three clusters of buds with cheese cloth, before any of them had expanded, and no seed was developed. Nectar is secreted by the base

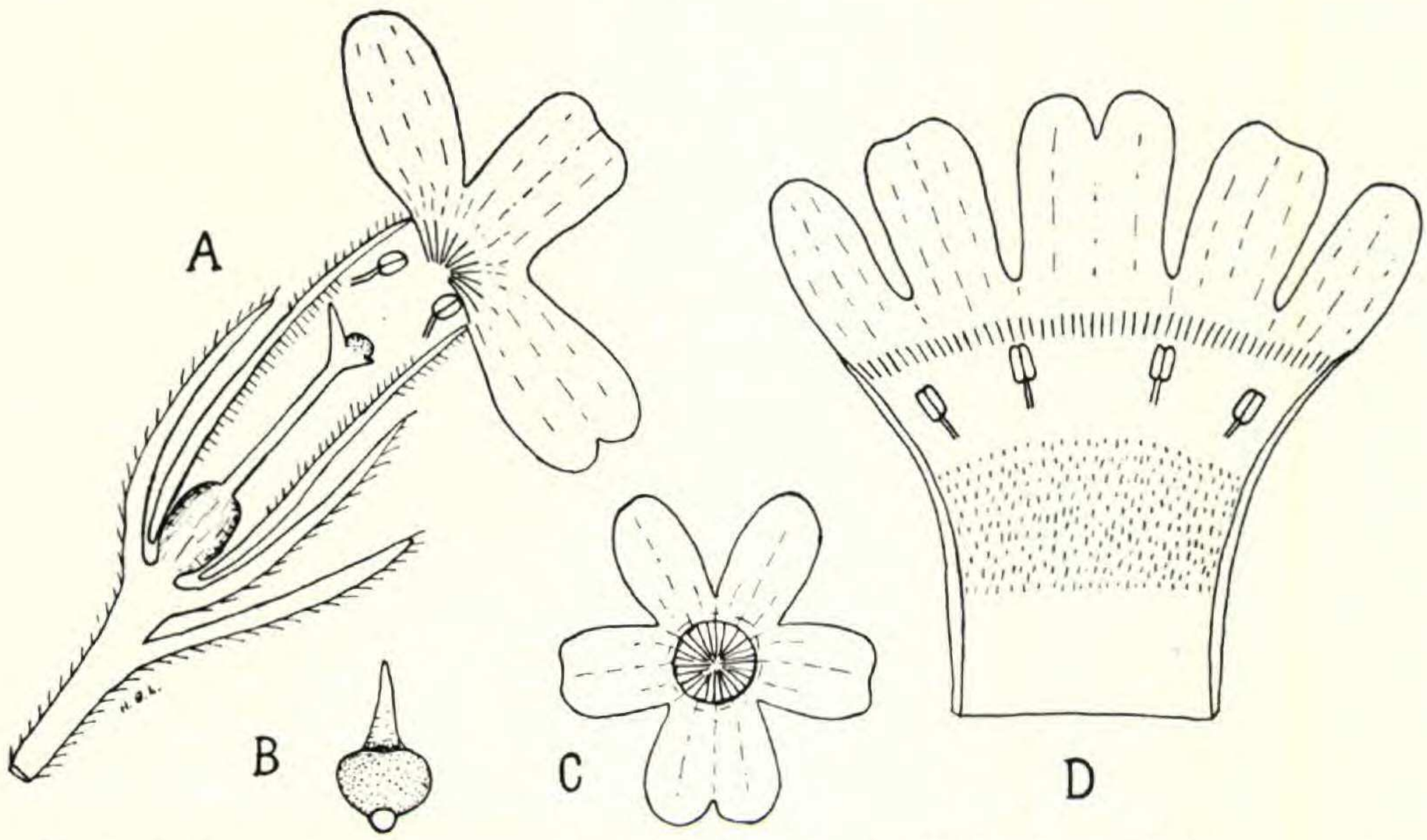

FIG. 1. VERBENA HASTATA L. A, Longitudinal Section of Flower, × 6; B, Stigma as seen from above, × 28; C, Flower from above, showing Grating of Hairs guarding Throat, × 4; D, Inside View of Corolla divided lengthwise with Margins reflexed, × 6.

of the corolla-tube, as was observed by Knuth[1] in the case of V. officinalis L.

When a bee, as a honey-bee, which can easily reach the nectar, for the first time inserts its tongue into a flower of the purple vervain, so little pollen adheres to it that it may or may not effect pollination; but when it is withdrawn wet with nectar, it is so well dusted with pollen that cross-pollination occurs when the bee visits another flower.

A list of the visitors is as follows:

BIRDS. *Trochilidae:* Trochilus colubris L.

HYMENOPTERA. APOIDEA. Long-tongued Bees—*Apidae:* Apis mellifera L. ♀. *Bombidae:* Bombus vagans Sm. ♀, B. terricola Say ♀, B. ternarius

[1] Blütenbiologie, Eng. Ed. Vol. III, page 242.

Say ☿, Psithyrus laboriosus Fab. ♀ ♂. *Euceridae:* Melissodes agilis var. aurigenia Cr. ♂, M. illata Lov. & Ckll. ♀ ♂. *Epeolidae:* Triepeolus donatus Sm. ♀, Epeolus pectoralis Rob. ♀, E. sp. ♀. *Nomadidae:* Nomada cuneata Rob. ♀.

Short-tongued Bees—*Andrenidae:* Andrena sp. ♀. *Halictidae:* Halictus lerouxii Lep. ♀ ♂, H. provancheri D. T. ♀ ♂, H. coriaceus Sm. ♀ ♂, H. pectoralis Sm. ♀. *Panurgidae:* Calliopsis andreniformis Sm. ♀ ♂. *Prosopididae:* Prosopis modesta Say, ♀.

SPHECOIDEA. *Bembecidae:* Bembex spinolae Lep.

LEPIDOPTERA. *Nymphalidae:* Argynnis aphrodite Fab. *Lycaeidae:* Colias philodicae Godt.

DIPTERA. *Dexiidae:* Rhyncodexia rufipennis Macq. *Syrphidae:* Eristalis transversus Wied., E. tenax L., Sphaerophoria cylindrica Say. *Tachinidae:* Echinomyia decisa Walk.

HEMIPTERA. *Pentatomidae:* Euschistus fissilis Uhl.

The length of the corolla-tube is 3.7 mm., and of the pistil 2.5 mm., so that the distance between the anthers and the stigma is hardly more than 1 mm. Thus the tongues of many visiting insects can come in contact with them, though not long enough to reach the nectar. The anthers open widely fully exposing the pollen, a large amount of which is often found in old flowers deposited on the glutinous stigma. Three to ten flowers in each circle may be in bloom at the same time.

The ruby-throated humming-bird, the only species of this family of birds found in New England, is only an occasional visitor. The most important pollinator of the purple vervain in this locality is the honey-bee, which visits the flowers very rapidly, as in one instance, 53 visits were counted in one minute. It moves more often from right to left than in the opposite direction, approximately speaking in the ratio of 2 to 1, but seldom traveling around the entire circle before visiting another spike.

The other long-tongued bees are all able to suck the nectar, and thus effect cross-pollination. Worker bumblebees are the most common visitors of this group.

The tongues of most short-tongued bees, as in the genus *Halictus*, where the tongue varies in length from 1 to 1.5 mm., are unable to reach the nectar. Of 46 specimens of this genus collected, 39 were males, belonging to common species. Why so many males were present it is difficult to explain, though they fly only in summer and autumn when the purple vervain is in bloom.

Butterflies are occasionally present, but find the small flowers rather difficult to visit. Most anthophilous flies feed on pollen, as the species of *Syrphus* but they can not reach the nectar, as their tongues

are only two millimeters long, but *Eristallis tenax*, which has a proboscis 7–8 mm. in length, can easily do so. Both the *Dexiidae* and *Tachinidae* can reach the pollen.

Only one specimen of the order Hemiptera was collected. *Euschistus fissilis*, of the *Pentatomidae*, has a hard, 4-jointed beak more than 4 mm. long. It also sucks the juices of leaves and of caterpillars.

Waldoboro, Maine

ADDITIONAL NOTES ON NAJAS IN MINNESOTA

C. O. Rosendahl

At the time *Najas olivacea* was described[1] it was known from only one station in Minnesota; namely, Norway Lake, Kandiyohi County, in the south-central part of the state, where it was first found in the late summer of 1932. It was again collected at the same place in 1933, but all subsequent attempts to obtain additional material of the species from the type locality have proved fruitless. The apparently complete disappearance of the species from Norway Lake is perhaps to be accounted for by the extensive lowering of the lake level following the severe droughts that prevailed in 1934 and again in 1936. A part of the zone of mucky bottom on which the plant was found has now become exposed, and over the remainder the water has apparently been too shallow for it successfully to maintain itself. Several lakes of the surrounding territory, most of which have suffered less lowering of levels, have been diligently searched for possible additional stations, but uniformly without success. However, in the early summer of 1937, Mr. John B. Moyle, of the State Conservation Department, discovered the plant growing in great abundance in Snail Lake, situated near the middle of Ramsey County, approximately 5 miles north of the St. Paul city limits. The new station is approximately 100 miles east-southeast of Norway Lake. Its proximity to the Twin Cities has offered opportunity for a more intimate acquaintance with this quite distinct yet apparently long overlooked member of our Najad flora, and the following notes are presented in the hope that they may be of help to those who are on the lookout for the species in other parts of the country.

The plant grows on somewhat mucky lake bottoms, most profusely

[1] Rosendahl and Butters, Rhodora **37**: 345. 1935.